Monitoring Student Creative Capacity: Using network visualisation to evaluate pedagogical practice

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Abstract
This paper explores how research in the fields of Social Network Analysis (SNA) and Business can be applied to monitoring the development of student creative capacity. SNA research has demonstrated the value of measuring and monitoring social networks for understanding the relationships and specific social positions required to promote creative development. For example, Burt (2004) has examined the application of SNA to assess uptake of 'creative ideas' within business organisations. The skills required both to tie and sustain linkages across disparate networks in an organisation, mirror many of the skills graduates need for productive participation within the future workforce. The application of social network methodologies provides an approach for visualising the formation of the student learning network and hence, the ability to evaluate individual creative capacity. Although there are multiple facets to building creative capacity, research suggests that an indicator of creativity can be identified within an individual's positioning in the social network. Thus, monitoring the development of student learning networks may afford educators the ability to identify individuals demonstrating those skills and attributes associated with creative capacity. This paper outlines a scalable quantitative approach for assessing pedagogical practices designed for this purpose.

Introduction: Creativity – A global imperative

The imperative for Higher Education Institutions (HEIs) worldwide to foster the creative attributes and skills graduates require for productive participation in the future workforce has been highlighted by commentators such as Florida (2004; 2005), Pink (2005), and Robinson (2000; 2007). Increasingly, social, economic and political researchers are noting that *creative capital* – the creative capacity that increases the productivity of organisations - is crucial to a rapidly changing economic and social world (Florida, 2002; Landry, 2000; Robinson, 2000). As Csikszentmihalyi (2006) recently stated, creativity is "no longer a luxury for the few, but…a necessity for all" (p. xviii). Ken Robinson (2000), author of "*Out of our minds: Learning to be creative*", stresses the urgency for HEIs to

commence teaching and learning practices that will foster the attributes and skills students require for the knowledge-society. Similarly, reports by the European Union Association (EUA) (2007) and the UK based National Advisory Committee on Creative and Cultural Education (NACCE) (1999) outline the pedagogical revisions necessary for educational institutions to develop graduate skills and attributes congruent with future workforce requirements. These graduate skills and attributes embody what Sternberg (2007), Jackson (2006), Craft (2006) and others have broadly called *creativity*.

The vast majority of Australian HEIs have responded to the social, political and economic call to action for developing graduate creative capacity by committing to creative learning outcomes and attributes within university policy documentation (McWilliam & Dawson, 2008). However, there is scant evidence of policy translation into 'creativity-enhancing' pedagogical practices. Research by Craft (2000; 2006), Jackson (2006) and McWilliam (2007) for example, is now addressing the issue of developing scalable creativity-focussed pedagogical practices for institutional adoption. However, there remain few examples of scalable adoption of creative practices, or tools for institutions to measure and demonstrate student creativity. This paper presents a methodology to enable educators with the tools necessary to identify and monitor student creativity and therefore, evaluate the implemented teaching practices designed to engender undergraduate creative capacity.

Networking as a creative capacity

There is now an emerging consensus that the core skills required for enacting creativity include: originality, imagination, communication, seeing connections, problem solving and team and individual leadership (Burt, 2004; Jackson, 2006; McWilliam, 2008 In press; Robinson, 2000; Tierney, Farmer, & Graen, 1999). A recent and all-inclusive definition is proposed by Plucker, *et al.* (2004) who define the construct as "the interaction between aptitude, process, and environment by which an individual or group produced a perceptible product that is both novel and useful as defined within a social context" (p. 90). The emphasis on interactivity prioritises an individual's ability to build social networks and optimise their value i.e., their ability to be an enterprising and agile networker. According to sociologist Ronald Burt (2004), individuals whose own networks can bridge other diverse networks and interest groups "are able to see early, see more broadly, and translate information across groups" (p. 354) and this in turn provides them with "a vision of options otherwise unseen" (p. 354). Burt sees this 'translating' or brokering function as value-adding creativity, not just because of the extent which 'translators' are able to move knowledge around in value-adding ways, but they build and expand "boundary-spanning relationships" (Geletkanycz & Hambrick, 1997, p. 654) within and outside the existing environment.

The importance of networking to creative capital is endorsed in the research of McWilliam and Dawson (2008), who draw an analogy with flocking behaviour of social organisms to illustrate the type of education that facilitates the development of creativity as a core workforce skill. McWilliam and Dawson name connectivity with diversity; and co-invention/co-creation with separation as two key pedagogical principles for building creative capacity. The emphasis on team or community oriented practices is also stressed by Mihalyi Csikszentmihalyi (1999) who insists that it is the community, not the individual, that is the unit of analysis appropriate to investigating creative capacity.

Likewise, Uzzi and Spiro (2005) discuss the need for socialisation in order to foster creative capacity. Uzzi and Spiro provide numerous examples of small teams, to

demonstrate that enterprising and agile networking is a valuable creative attribute developed through sustained network interactions (the blending of social and cognitive contexts). They argue that, while the efficiency of information flow and the generation of ideas are enhanced within small team based networks, this can collapse into *intense* homophily or what the business discipline refers to as un-creative 'group-think'. By implication, teaching and learning for creativity needs to assist students to move beyond their immediate class or group to link with disparate groups, ideas, literature and products, in order to make new connections, to innovate and to 'translate' knowledge through networking.

Social network analysis

Research undertaken by Burt (2004) demonstrates that, when individual actors on the edges of a social network are able to link other previously disparate groups, they exhibit greater degrees of *enterprise* and *agility* than peers positioned within small team networks (See Figure 1). While separate small team networks potentially exhibit varying degrees of group-think, these individuals link across the network gaps, or what Burt has termed 'structural holes', to re-seed the community with new ideas, products and processes. Rodan and Galunic (2004) demonstrated that individuals accessing a diversity of disparate small team networks acts to promote the introduction of new knowledge, thereby facilitating innovation and creativity.

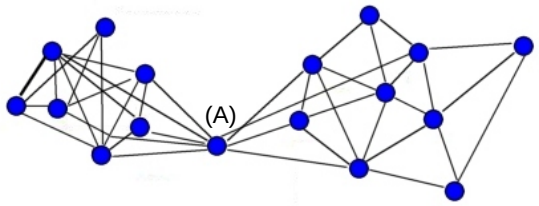

Figure 1: Example social network – illustrating an individual (A) bridging a 'structural hole'.

In a similar vein, Malcolm Gladwell (2002) author of *The tipping point: How little things can make a big difference*, identifies three types of nodes within a network that can influence the uptake of ideas and the explosion of new trends. Gladwell suggests that the uptake of ideas or the achievement of systemic change is not reliant upon significant numbers of a population simultaneously enacting change. The author argues that rapid growth and uptake is accomplished by a few individuals demonstrating exceptional behaviour. Gladwell categorises these exceptional individuals within a network as *"connectors", "mavens"* or *"salesmen"*. *Connectors* are described as having contact with vast numbers of additional nodes. *Mavens* are defined as information specialists or discipline experts with a predilection for dissemination. Finally, *Salesmen* are persuaders who encourage adoption and action. Gladwell's description of a *Maven* is comparable to Burt's discussion of individuals bridging structural holes and thereby joining disparate small team networks. In both contexts, these linking individuals are pivotal for evaluating, translating, adapting and then disseminating ideas and information.

Within the higher education environment, communities of practice among academic staff and learning communities among students demand more than the generation of a single good idea or shared need in order to thrive. Effective leadership is essential, and this leadership often takes the form of identifying or creating opportunities for individuals to act as links across structural holes. We would hypothesize, therefore, that an analysis of the social networks associated with effective communities of practice and learning communities would reveal significant nodes where this linking work was being done. The creative leader of such communities can identify, enable, support, and reward these individuals their abilities to enhance creative capacity of the network.

Skills such as networking, leadership, communication, dissemination and evaluation are thus core skills for developing student creative capacity. Additionally, through the establishment of connections across disparate small team networks, creative students reduce the likelihood of group-think and increase their own capacity to act as a creative 'broker'. To do so, however, they require the skills for self-fashioning (shared language, knowledge and priorities) and the agility needed to move quickly across and within numerous networks to re-purpose information for new audiences. For this reason the identification and monitoring of small team networks and the individuals who can bridge network gaps, is central to understanding two elements of creative capacity – networking enterprise and agility.

The study of social network analysis (SNA) provides an established methodology for evaluating and monitoring the development of individual and team creativity. Tepper (2006) suggests that SNA as a methodology has the capacity to identify the key individuals and small team networks associated with creative outcomes. Thus, the application of SNA within the field of education can begin to provide explicit evidence of creativity as a learning outcome, a graduate attribute, and can also evaluate the specific pedagogies designed to foster creative capacity.

ICT data – scalable assessments of student social networks

A further challenge that now arises is how best to visualise the team networks within the learning environment so that educators may adapt and alter their specific learning and teaching activities to develop student creativity. The vast majority of HEIs internationally and nationally, have adopted Information and Communication Technologies (ICTs) to enhance flexibility and access for student learning. These ICTs have largely taken the form of Learning Management Systems (LMS) such as BlackBoard and WebCT Vista. A key feature of these systems is the ability of students to interact with peers and staff via computer mediated communications (CMC) such as discussion forums and online chat. Additionally, because the LMS automatically logs data related to student online interactions, there is an opportunity for extracting explicit information about the student social network. Dawson (2006a; 2006b; 2007), has demonstrated the value of data-mining institutional LMS for enhancing teaching practice. This work highlights the benefits associated with analysing LMS data in order to establish pedagogical lead indicators that can assist educators in assessing teaching practices in a proactive and timely manner.

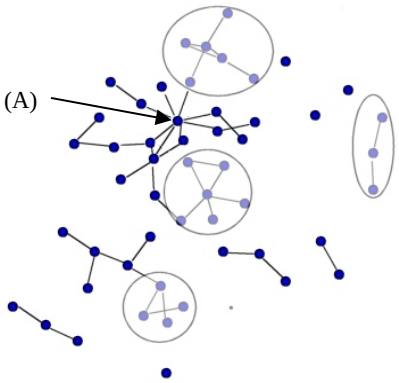

Figure 2: Sociogram of student discussion forum interactions. Clusters of small team student networks and a student (A) occupying a linking position are illustrated.

More recently, Dawson (In press) has investigated the capacity for extracting LMS derived data to form a representation of the student social network (Figure 2). While the author relates the SNA findings to student sense of community rather than creative capacity *per se*, the study does demonstrate the usefulness of ICT data in informing and guiding educators in the implementation and evaluation of their teaching practice. Furthermore, the study demonstrates that it is possible to extract LMS data to form opportunistic representations of the student social network. As the data is tracked over time, an examination can be generated of the evolving social network and the individual

position students occupy within the network at key trigger points. This data can then be used to inform the implementation of the creativity-centric pedagogical practice. This feedback mechanism is pro-active, scalable, on-going, unobtrusive and naturally occurring as a result of the events and interactions in the online environment.

The generation of the student sociograms allows for the identification of individual students linking potentially disparate clusters into a networked community. McWilliam and Dawson (2008) have described these individuals as 'border crossers'. Border crossers demonstrate the enterprise and agility required for bridging the network gaps and introducing new knowledge, ideas and processes to the larger network. In summary, the identification of these individuals and the changing dynamics of the social network can differentiate some of the creative capacities developing within the student cohort. Educators can use this evidence to alter their learning and teaching activities and then observe any effective changes in network behaviour.

Conclusion

This paper has outlined how current research within the fields of SNA and Business can be juxtaposed to provide new insights and opportunities for educators to monitor the impact of implemented pedagogies designed to foster student creative capacity. The application of social network methodologies offers a proactive approach for visualising the formation of the student learning network and hence, the ability to evaluate both individual creative capacity and the learning and teaching activities designed to promote creative engagement.

As the adoption of Web 2.0 technologies within the education sector gains momentum, there will be increasing opportunities to further observe and record not only the impact of specific teaching practices but also student behavioural responses. Access to this data will be enabled by more sophisticated technologies, but this needs to be matched by an equivalent pedagogical sophistication. By bringing pedagogical theory to bear on the validating of the interpretation of data related to student social networks, it is possible to see how students are located, and locate themselves, in social learning networks that may or may not enhance their opportunities for creative thinking and doing. Once their social networking capacity can be recorded and triangulated with academic performance and other information, it can be demonstrated as a graduate attribute in a student portfolio. Moreover, analysis of networking within an entire class or program group can provide academic teachers with valuable information about whether and how their students are making connections within and outside their group, and can work systematically to assist them with this. Once this is achieved, learner-centeredness becomes more than a rhetorical flourish on teaching and learning policy documents. It can be the reality of the student learning experience.

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